FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **27020/37460**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): 09/857596

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/GB99/04161	**10 December 1999**	**11 December 1998**

TITLE OF INVENTION

BREATHABLE ARTICLES AND FABRICS

APPLICANT(S) FOR DO/EO/US

Nigel John Middleton

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

    postcard

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/857596	PCT/GB99/04161	27020/37460

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		CALCULATIONS PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1000.00	
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$860.00	
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$710.00	
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$690.00	
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =		$860.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	38 - 20 =	18	x $18.00	$324.00
Independent claims	1 - 3 =	0	x $80.00	$0.00
Multiple Dependent Claims **(check if applicable).**			☐	$0.00
TOTAL OF ABOVE CALCULATIONS =				$1,184.00
☐ Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				$0.00
SUBTOTAL =				$1,184.00
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				$0.00
TOTAL NATIONAL FEE =				$1,184.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				$0.00
TOTAL FEES ENCLOSED =				$1,184.00
			Amount to be: refunded	$
			charged	$

a. ☒ A check in the amount of **$1,184.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **13-2855** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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REGISTRATION NUMBER

7 June 2001

DATE

Patent
27020/37460

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:

Nigel John MIDDLETON

Serial No.: Not Yet Assigned
(U.S. National Phase of
PCT/GB99/04161)

For: BREATHABLE ARTICLES
AND FABRICS

Filed: **June 7, 2001**

Group Art Unit: Not Yet Assigned

Examiner: Not Yet Assigned

I hereby certify that the documents referred to as enclosed therewith are being deposited with the United States Postal Service on **June 7, 2001**, in an envelope addressed to BOX PCT, Commissioner for Patents, Washington, D.C. 20231 utilizing the "Express Mail Post Office to Addressee" service of the United States Postal Service under Mailing Label No. **EK827657676US**.

Richard Zimmermann

PRELIMINARY AMENDMENT

Commissioner for Patents
Box: Non-Fee Amendment
Washington, D.C. 20231

Dear Sir:

Before examining the above-referenced application, please enter the following amendments and consider the following remarks:

In the Claims:

Please amend claims 6, 8, 9, 11, 15, 17, 18, 19, 20, 21, 27, 28, 29, 31, 35, 37 and 39 in the following manner.

6. (Amended) A breathable article according to claim 1, wherein the spacer members project by a distance which is substantially the same across the relevant major face of the sheet, so that the article conforms in use to the shape of the person or animal or the surface.

8. (Amended) A breathable article according to claim 1, wherein the spacer members are discontinuous.

9. (Amended) A breathable article according to claim 1, wherein the spacer members are continuous.

11. (Amended) A breathable article according to claim 9, wherein the spacer members comprise a network of ribs on the respective side or sides of the sheet.

15. (Amended) A breathable article according to claim 1, wherein the sheet further includes a hollow depression or chamber provided in the first major face of the sheet in the region of each perforation.

17. (Amended) A breathable article according to claim 15, wherein at least one of the depressions or chambers is associated with more than one perforation.

18. (Amended) A breathable article according to claim 15, wherein the second major face of the sheet is provided with a dome projection in the region of each perforation, each dome projection corresponding with a hollow depression or chamber of the first major face of the sheet.

19. (Amended) A breathable article according to claim 1, when permanently or releasable affixed to the surface.

20. (Amended) A breathable article according to claim 1, being a cushioning or lining article for locating between a person or animal and a surface selected from the surfaces of apparel and clothing and portions thereof, seats and portions thereof, wheelchairs and portions thereof, headwear, footwear, body protectors, body armour, sports shields, bedding, upholstery coverings, orthopaedic casts, orthopaedic supports, orthopaedic hard braces, and other articles against which the body of the person or animal, or a portion thereof, can be compressed in use.

21. (Amended) A breathable article according to claim 1, being a medical or veterinary dressing.

27. (Amended) A breathable fabric according to claim 22, wherein the spacer members project by a distance which is substantially the same across the relevant major face of the sheet.

28. (Amended) A breathable fabric according to claim 22, wherein the spacer members are discontinuous.

29. (Amended) A breathable fabric according to claim 22, wherein the spacer members are continuous.

31. (Amended) A breathable fabric according to claim 29, wherein the spacer members comprise a network of ribs on the respective side or sides of the sheet.

35. (Amended) A breathable fabric according to claim 22, wherein the sheet further includes a hollow depression or chamber provided in the first major face of the sheet in the region of each perforation.

37. (Amended) A breathable fabric according to claim 35, wherein at least one of the depressions or chambers is associated with more than one perforation.

38. (Amended) A breathable fabric according to claim 35, wherein the second major face of the sheet is provided with a dome projection in the region of each perforation, each dome projection corresponding with a hollow depression or chamber of the first major face of the sheet.

REMARKS

By way of this preliminary amendment, claims 6, 8, 9, 11, 15, 17, 18, 19, 20, 21, 27, 28, 29, 31, 35, 37 and 39 have been amended to remove multiple dependencies. It is respectfully submitted that all pending claims are in condition for allowance and early notice to that effect is earnestly solicited.

Respectfully submitted,

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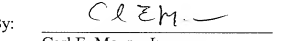
By: 

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June 7, 2001

502857

MARKED-UP VERSION

OF AMENDED CLAIMS

6. (Amended) A breathable article according to [any preceding] claim 1, wherein the spacer members project by a distance which is substantially the same across the relevant major face of the sheet, so that the article conforms in use to the shape of the person or animal or the surface.

8. (Amended) A breathable article according to [any one of the preceding claims] claim 1, wherein the spacer members are discontinuous.

9. (Amended) A breathable article according to [any one of claims 1 to 7] claim 1, wherein the spacer members are continuous.

11. (Amended) A breathable article according to claim 9 [or 10], wherein the spacer members comprise a network of ribs on the respective side or sides of the sheet.

15. (Amended) A breathable article according to [any preceding claim] claim 1, wherein the sheet further includes a hollow depression or chamber provided in the first major face of the sheet in the region of each perforation.

17. (Amended) A breathable article according to claim 15 [or 16], wherein at least one of the depressions or chambers is associated with more than one perforation.

18. (Amended) A breathable article according to [any one of claims 15 to 17] claim 15, wherein the second major face of the sheet is provided with a dome projection in the region of each perforation, each dome projection corresponding with a hollow depression or chamber of the first major face of the sheet.

19. (Amended) A breathable article according to [any one of the preceding claims] claim 1, when permanently or releasable affixed to the surface.

20. (Amended) A breathable article according to [any one of the preceding claims] claim 1, being a cushioning or lining article for locating between a person or animal and a surface selected from the surfaces of apparel and clothing and portions thereof, seats and portions thereof, wheelchairs and portions thereof, headwear, footwear, body protectors, body armour, sports shields, bedding, upholstery coverings, orthopaedic casts, orthopaedic supports, orthopaedic hard braces, and other articles against which the body of the person or animal, or a portion thereof, can be compressed in use.

21. (Amended) A breathable article according to [any one of claims 1 to 19] claim 1, being a medical or veterinary dressing.

27. (Amended) A breathable fabric according to [any one of claims 22 to 26] claim 22, wherein the spacer members project by a distance which is substantially the same across the relevant major face of the sheet.

28. (Amended) A breathable fabric according to [any one of claims 22 to 27] claim 22, wherein the spacer members are discontinuous.

29. (Amended) A breathable fabric according to [any one of claims 22 to 27] claim 22, wherein the spacer members are continuous.

31. (Amended) A breathable fabric according to claim 29 [or 30], wherein the spacer members comprise a network of ribs on the respective side or sides of the sheet.

35. (Amended) A breathable fabric according to [any one of claims 22 to 34] claim 22, wherein the sheet further includes a hollow depression or chamber provided in the first major face of the sheet in the region of each perforation.

37. (Amended) A breathable fabric according to claim 35 [or 36], wherein at least one of the depressions or chambers is associated with more than one perforation.

38. (Amended) A breathable fabric according to [any one of claims 35 to 37] claim 35, wherein the second major face of the sheet is provided with a dome projection in the region of each perforation, each dome projection corresponding with a hollow depression or chamber of the first major face of the sheet.

BREATHABLE ARTICLES AND FABRICS

FIELD OF THE INVENTION

The present invention relates to breathable articles, and more particularly articles that in use are disposed between a part of a body of a person or animal and a surface (which may optionally be perforated). Such articles may, for example, include apparel of all types (e.g. watersports apparel), parts of wheelchairs, seats of all types (e.g. automotive seating, office seating, domestic seating, boat seating, commercial travel seating such as bus, train and aircraft seating), headwear of all types, shoe insoles, helmet linings, linings for body protection or body armour, lining for sports shields such as shin-pads, under-blankets for bedding, upholstery covers, linings for clothing, medical dressings, orthopaedic cast linings or linings for orthopaedic supports or hard braces. The articles may also include medical and veterinary dressings, which may for example be held onto the body by an overlying cover member or by winding the dressing onto itself around the part of the body. The word "article" used herein includes portions of articles. The invention also relates to breathable fabrics from which such articles (and others) can be manufactured.

DESCRIPTION OF THE PRIOR ART

International (PCT) Patent Application No. WO-A 91/12958 (Armstrong and Middleton) (the disclosure of which is incorporated herein by reference) discloses a breathable insulating fabric in which perforations are provided, the fabric being so configured in the region of each perforation that on one side of the fabric a dome projection extends and on the other side a hollow depression chamber is provided in the fabric (Fig. 2a). In an alternative construction, the dome may be omitted (Fig. 1). The dome version is marketed by Micro Thermal Systems Limited of Bodmin, UK (tel: +44 1208 79999; fax: +44 1208 79990), under the trade mark STOMATEX.

BACKGROUND OF THE INVENTION

A disadvantage of known breathable fabrics lies in the fact that the breathing action can be inhibited if an article made from the fabric is disposed between a part of a body of a person or animal and a surface. The disadvantage is particularly serious if the surface is hard and/or unperforated and/or if there is a positive external pressure on the article, for example from the weight of the person or animal or from the surface being held tightly against the article.

It is an object of the present invention to go at least some way towards overcoming the above disadvantage, or at least to provide an alternative to the existing products.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, therefore, there is provided an article comprising a sheet having first and second major faces directed respectively to first and second sides of the article and adapted to be disposed at least intermittently in use between, to the first side, a part of a person or animal and, to the second side, a surface, the sheet being formed of a substantially impermeable material having perforations provided therethrough, characterised in that there is further provided a plurality of spacer members which project from at least one of the said major faces of the sheet between perforations of the sheet for spacing the sheet from the said part of the person or animal, from the said surface, or from both of these, whereby in use between both the surface and the part of a person or animal the article is breathable to restrict discomfort to the person or animal.

According to a second aspect of the present invention, there is provided a breathable fabric, for use particularly, but not exclusively, in manufacturing an article according to the first aspect of the present invention, the fabric comprising a sheet having first and second major faces and formed of a substantially impermeable material having perforations provided

therethrough, characterised in that there is further provided a plurality of spacer members which project from at least one of the major faces of the sheet between perforations of the sheet for spacing the sheet in use from a part of a person or animal, from a surface, or from both of these on opposite major faces of the sheet.

In a particular embodiment, the spacer members project from at least the second major face of the sheet (optionally from only the second major face of the sheet) for spacing the sheet from the said surface.

In a further embodiment, the spacer members may project from at least the first major face of the sheet (optionally from only the first major face of the sheet) for spacing the sheet from the person or animal.

In a preferred form of the invention, the sheet further includes a hollow depression or chamber provided in the first major face of the sheet in the region of each perforation. In the way described in WO-A 91/12958, such an arrangement permits air passing from the first to the second side of the article to accumulate in the depression or chamber under increased vapour pressure prior to passing out to the second side of the article.

Furthermore, one depression or chamber may be associated with more than one perforation. The cross-dimension of the depression or chamber may, for example, be in the range of about 0.4 mm to about 50 mm, more typically about 0.4 mm to about 30 mm. The surface density of depressions or chambers on the sheet may be up to about 500,000 m^{-2}, for example between about 200 and about 500,000 m^{-2}. The size and surface density of depressions or chambers can be chosen by one or ordinary skill in the art, according to the breathability properties required. For example, a surface density of over 100,000 small depressions or chambers per m^2, with associated perforations typically having a cross-dimension of less than about 0.1 mm, e.g. possibly as low as about 0.01 mm, may be useful for specialised articles such as medical or veterinary dressings or other coverings.

The thickness of the sheet may be chosen to suit the desired application of the article. For example, the thickness may be from 0.5-100 mm, e.g. less than about 50 mm, particularly from 1-30 mm, most particularly from about 3 to about 15 mm.

The perforations may be of any convenient or advantageous shape, e.g. circular, slit-like or elliptical, when viewed along their lengths, and suitably have a cross-dimension up to about 5 mm (e.g. from about 0.01 mm to about 5 mm). The perforations are suitably about the size of a pin-prick, e.g. about 0.2 to about 2 mm in diameter. The centres of adjacent perforations may suitably be up to about 100 mm, e.g. up to approximately 30 mm, apart and the perforations may be arranged in a repeating diamond pattern across the sheet.

The expression "fabric" used herein includes a fabric portion, and the expression "sheet" includes a sheet portion.

The spacer members may, for example, project from the sheet by a distance which is substantially constant across at least the majority of the relevant major face of the sheet, so that the article conforms in use to the shape of the person or animal or the surface. Alternatively, the spacer members may be of variable length in the direction away from the sheet, for example to accommodate specific contours of the surface or the person or animal's body. The spacer members may be discontinuous or continuous. They may suitably comprise ribs or discrete or point projections extending from the sheet. The spacer members may, for example, be attached to the sheet or may be integral with the sheet.

The substantially impermeable sheet may be a unitary sheet or a laminate, and is preferably elastomeric. The component(s) may be foamed or unfoamed. If foamed, the foam structure can be closed-cell or open-cell. While an open-cell foam will normally have some inherent permeability, such a foam is still understood to be "substantially impermeable" in the context of the present invention if the presence of perforations makes a recognisable improvement to breathability. Suitable elastomeric materials include synthetic

and natural rubbers, for example neoprene rubber, and/or synthetic polymers of all types. In the case of a laminate, different materials may if desired be used for different lamina.

The sheet is preferably a sheet of the general STOMATEX type described above. Most preferably, the second major face of the sheet is provided with dome projections in the region of each perforation, corresponding with the hollow chambers of the first major face of the sheet. In use, the domes flex as the pressure changes take place in the chamber, and this flexing assists in the removal of moist air away from the person's skin adjacent the first major face of the sheet.

In this preferred embodiment, the spacer members are adapted to maintain the domes spaced from the surface and thereby to prevent inhibition of the flexing action during normal use.

The spacer members preferably project from the second major face of the sheet by an amount which is substantially the same across at least the majority of the second major face of the sheet, so that the article conforms in use to the shape of the surface. The spacer members are preferably of sufficient resilience that the perforations of the sheet remain open to the second side of the article during normal use, i.e. so that the second side of the article is not normally pressed against the surface.

The spacer members may suitably comprise a network of ribs extending across substantially all of at least one side of the article or fabric, the ribs thereby providing walls beside each dome projection of the second major face of the sheet. If desired, the air space thereby defined over the dome projections can be covered by an air-permeable sheet cover member extending between the ribs and secured (e.g. sealed) thereto.

In a particularly preferred arrangement an air-permeable sheet cover member may be a water-absorbent cloth or other fabric, e.g. of hydrophilic fibres such as high-wicking microfibres, particularly polyesters. Such a cover member provides a high wicking action which absorbs moisture passing out

through the perforations of the sheet from the first to the second major face of the sheet. In this way, the surface against which the article is located can be maintained as dry as possible. Alternatively, the air-permeable sheet cover member may, for example, be a waterproof but vapour-permeable membrane. Still further, such a waterproof but vapour-permeable membrane may be used together with a water-absorbent fabric, e.g. externally of the water-absorbent fabric to confer waterproofness. If desired, such a composite may be a laminate with the different layers being bonded together in conventional manner.

The surface which in use overlies the article of the present invention and is spaced therefrom by the spacer members of the sheet may be rigid or flexible, perforated or unperforated, permeable or impermeable. The article of the present invention can also be wound around a part (e.g. a limb) of a person or animal's body, in which case the overlying around a part of a person or animal's body, the surface will be the first major face of that portion of the sheet which is wound over the portion of the sheet adjacent the person or animal's body, i.e. the article (e.g. a bandage) will be wound over itself.

The article of the present invention may, for example, take the form of the following cushioning and lining articles permanently or releasable affixed to any surface, or for wearing between a person or animal's skin and any surface:

(a) apparel of all types, such as watersports apparel, and portions of such apparel (e.g. the seat portions of trousers);

(b) the fabric portions of wheelchairs (e.g. the seat, back and armrest portions);

(c) seats of all types, such as automotive seating, office seating, domestic seating, boat seating, commercial travel seating (e.g. bus, train and aircraft seating);

(d) headwear of all types;

(e) boot and shoe insoles and linings, in which case the surface is the interior surface of the boot or shoe;

(f) helmet linings, in which case the surface is the interior surface of the helmet;

(g) linings for body protectors, in which case the surface is the interior surface of the body protector;

(h) linings for body armour, in which case the surface is the interior surface of the body armour;

(i) linings for sports shields such as shin-pads, in which case the surface is the interior surface of the sports shield;

(j) under-blankets for bedding, in which case the surface is the upper surface of a mattress or the like;

(k) upholstery covers, in which case the surface is the surface of the upholstery;

(l) linings for clothing, in which case the surface is the interior surface of the clothing;

(m) orthopaedic cast linings, in which case the surface is the interior surface of the orthopaedic cast;

(n) linings for orthopaedic supports or hard braces, in which case the surface is the interior surface of the orthopaedic support or hard brace; and

(o) portions of the above if not specifically mentioned, particularly portions that are subjected to compressive forces in use.

The article of the present invention may also take the form of medical or veterinary dressings, which may for example be held onto the body by an overlying member (optionally with or without a contact adhesive between the dressing and the skin of the person or animal) or by winding the dressing onto itself around a part of the body (e.g. a limb).

The basic principle underlying the preferred mode of action of the perforations of the sheet is set out in WO-A 91/12958. This basic principle is

retained when a corresponding sheet is provided with spacer members according to the present invention. In essence, evaporation of sweat from the skin surface of the person causes an increase in the vapour pressure (density) within the hollow chambers of the sheet. Movement of the person's body, for example by walking in the case of an insole as the article of the present invention, will cause compression of the sheet and consequent distortion of the chambers and the domes. This leads to active pumping of the vapour from the chambers, through the perforations and out to the second side of the article. Here it will tend to condense, because the temperature is lower away from the wearer's body.

When the spacer members are provided with an air permeable, hydrophilic fibre, absorbent sheet cover member, enclosing an air space over the dome projections of the second major face of the sheet, condensed sweat will be absorbed into the fibres of the absorbent cover member. Sweat may not pass back through the perforations after condensation. Even when the sweat is still vaporous in the air space over a dome projection, it will not return to the chambers of the first major face of the sheet due to the positive thermal and diffusion gradient from the first to the second major face of the sheet.

The perforations and associated chambers are suitably of sufficient size and spacing apart to permit the natural biological functions of the user's skin to continue substantially unhindered over a desired period of time, while permitting a controlled (but not excessive) retention of the user's body heat.

The components of the article or fabric should be non-toxic, non-irritant and comfortable to wear (in the sense of lightweight, flexible and soft to the touch), as well as being resistant to attack and degradation from all natural by-products of the user's body (e.g. sweat, blood, tissue fluid, urine, pus, and gases such as carbon dioxide).

It is preferred that the article will provide substantial protection to the wearer from cold or other external hazards (e.g. water, chemicals, bacteria, air

etc), while permitting an enhanced air-exchange efficiency as soon as high levels of wearer activity arise, which cause the perforations to open due to flexing of the article and/or the higher temperatures and pressures within the chambers of the sheet. In such articles, the perforations may conveniently be interspersed with smaller numbers of other types of perforation according to the present invention and/or other (e.g. conventional) perforations. In one particular form, the perforations open when the vapour pressure of moisture in the chamber(s) reaches saturated vapour pressure.

By selecting particular elastomeric materials, particular lamina thicknesses, particular sizes of chambers and perforations, different concentrations of perforations over the sheet area and/or different arrangements of perforation types over the area of the sheet, the article's properties can be adjusted to suit the intended use. Moreover, by careful selection of materials and configuration, the article can be made to respond in its "breathability" to variations in external conditions and/or in the user's biological functions, so that to some extent such articles can self-regulate their "breathability" and hence automatically control the environment next to the wearer's skin within a pre-set temperature range.

The fabric and articles made therefrom may be manufactured according to conventional methods. Thus, for example, a foamed or unfoamed elastomeric sheet can be press-formed, e.g. by thermoformation under pressure, or vacuum-formed, to provide the required chambers, domes and space members and the sheet can be perforated by pins to provide the perforations. The perforation of the sheet can be simultaneous with the press-forming or vacuum-forming or at a different time from the press-forming or vacuum-forming.

Alternatively, the spacer members can be laminated to the remainder of the sheet. This will be appropriate when the resilience of the spacer members must be different from that of the perforated portion of the article. In such a method, a first sheet portion of a first elastomeric material may be press-

formed or vacuum-formed to provide the required chambers and domes and the sheet can be perforated by pins to provide the perforations. As before, the perforations of the sheet can be simultaneous with the press-forming or vacuum-forming or at a different time from the press-forming or vacuum-forming. A second sheet portion of a second elastomeric material (typically different from the first elastomeric material) can have relatively large holes punched through it, which are large enough to comfortably receive the domes projecting from the first sheet portion. The two sheet portions can be laminated together in this configuration, whereby the second sheet portion provides the space members according to the present invention.

Where additional permeable layers are to be laminated or bonded to the fabric, e.g. across the spacer members to enclosed an air space above the domes to the second major face of the sheet, this lamination or bonding may be achieved in conventional manner, using known materials and methods.

The present invention goes at least some way to providing a simple, inexpensive, comfortable, insulating, washable and effective lining system for wearing between a person or animal and an outer covering, thereby addressing the problems described above in the introduction.

BRIEF DESCRIPTION OF THE DRAWINGS

For ease of understanding of the present invention, and to show how it may be carried into effect, embodiments will now be described, purely by way of example and without limitation, with reference to the accompanying drawings, in which:

Figure 1 shows a partially cut away perspective top view of a fabric from which a breathable article can be manufactured.

Figure 2 shows a schematic side view of part of the fabric of Figure 1; and

Figure 3 shows an enlarged schematic side view of part of a modified fabric incorporating a cover member to enclose an air space over the second major face of the sheet.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, in which like parts are designated alike, there is shown a fabric sheet 1 from which a breathable article can be manufactured. The fabric sheet has first 2 and second 3 major faces defining first and second sides of the fabric. These first and second major faces of the fabric sheet 1 would be directed towards corresponding first and second sides of the finished article. In use, an article manufactured from the fabric would be near a person or animal's skin 4, the person/animal being to the first side 2 of the fabric and a surface 5 being to the second side 3 of the fabric so that the article is disposed between the person/animal and the surface.

The fabric sheet 1 consists of a sheet formed of foamed elastomeric neoprene having small pin-prick sized perforations 6 provided therethrough. Circular hollow chambers 7 are provided in the first major face 2 of the sheet, one in the region of each perforation 6, so that a perforation coincides with the apex of each chamber. The second major face 3 of the sheet is provided with dome projections 8, one in the region of each perforation 6, so that a perforation also coincides with the apex of each dome.

The arrangement permits air passing from the first to the second side of the fabric to accumulate in a chamber 7 under increased pressure prior to passing out through the perforation 6 to the second side of the fabric. During this process, the elastomeric sheet can flex, both under the effect of the pressure changes and as a result of mechanical bending. These flexing movements contribute to a positive pumping effect which causes an efficient transfer of moisture-laden air through the fabric from its first to its second side.

There are further provided a plurality of spacer members in the form of ribs 9 which project from the second major face 3 of the sheet between the perforations 6 and serve to space an article made from the fabric from the surface 5, whereby the flexing action can continue unhindered, even if the person's weight tends to squash the article 1 against the surface 5.

The elastomeric materials may, if desired, be covered by a thin layer of a skin-compatible material (not shown), which may suitably be a woven natural and/or synthetic cloth, comprising cotton, nylon or mixtures thereof. The ribs 9 are shown integral with the sheet, but may alternatively be laminated to the sheet as described generally above.

Referring particularly to Figure 3, the sheet 1 may further have a water-absorbent fabric layer 10 (e.g. a hydrophilic microfibre woven fabric) bonded to the ribs 9 so as to enclose an air space above the dome projections 8, each air space being bounded by a projection 8, the ribs 9 and the water-absorbent fabric layer 10. As described above, the water-absorbent fabric layer may, if desired, be replaced or supplemented by a waterproof but vapour-permeable membrane, for example to confer waterproofness.

The absorbent fabric layer 10 preferably exhibits a high wicking effect and absorbs any liquid water which contacts it. This retains moisture within the fabric, and restricts condensation on the surface 5. The fabric is easily replaced or washed periodically to eliminate the accumulated moisture. Provided that it is hygienic and acceptable to do so, the fabric could alternatively be dried overnight for reuse, without washing.

The illustrated fabric is suitably manufactured by conventional press-forming or vacuum-forming of a foamed neoprene sheet, to form the chambers 7, domes 8 and spacer members 9. If desired, the water-absorbent fabric layer 10 may be bonded to the spacer members 9 in conventional manner using conventional contact adhesives. The perforations 6 may suitably be formed by pins, optionally simultaneously with the press-forming step.

The illustrated fabric is found to maintain its breathability and the advantages of the active pumping effect of the domes 8 and chambers 7, even when it is being compressed by the weight of a person. This significant advantage has not hitherto been available, and has severely limited the application of advanced breathable fabrics to uses as linings within a relatively tightly fitting outer covering.

The foregoing broadly describes the present invention without limitation to the particular illustrated embodiments. Variations and modifications as will be readily apparent to those of ordinary skill in this art are intended to be included within the scope of this application and subsequent patent(s).

What Is Claimed Is:

1. An article comprising a sheet having first and second major faces directed respectively to first and second sides of the article and adapted to be disposed at least intermittently in use between, to the first side, a part of a person or animal and, to the second side, a surface, the sheet being formed of a substantially impermeable material having perforations provided therethrough, characterised in that there is further provided a plurality of spacer members which project from at least one of the said major faces of the sheet between perforations of the sheet for spacing the sheet from the said part of the person or animal, from the said surface, or from both of these, whereby in use between both the surface and the part of a person or animal the article is breathable to restrict discomfort to the person or animal.

2. A breathable article according to claim 1, wherein the spacer members project from at least the second major face of the sheet for spacing the sheet from the said surface.

3. A breathable article according to claim 2, wherein the spacer members project from only the second major face of the sheet.

4. A breathable article according to claim 1, wherein the spacer members project from at least the first major face of the sheet for spacing the sheet from the person or animal.

5. A breathable article according to claim 4, wherein the spacer members project from only the first major face of the sheet.

6. A breathable article according to any preceding claim, wherein the spacer members project by a distance which is substantially the same

across the relevant major face of the sheet, so that the article conforms in use to the shape of the person or animal or the surface.

7. A breathable article according to claim 6, wherein the spacer members project from the second major face of the sheet and have a sufficient resilience that the perforations of the sheet remain open during normal use and the second side of the article is not normally pressed against the surface.

8. A breathable article according to any one of the preceding claims, wherein the spacer members are discontinuous.

9. A breathable article according to any one of claims 1 to 7, wherein the spacer members are continuous.

10. A breathable article according to claim 9, wherein the continuous spacer members extend across substantially all of at least one side of the sheet.

11. A breathable article according to claim 9 or 10, wherein the spacer members comprise a network of ribs on the respective side or sides of the sheet.

12. A breathable article according to claim 11, wherein an air-permeable sheet cover member extends between adjacent ribs and is secured thereto to enclose an air space between the ribs.

13. A breathable article according to claim 12, wherein the air-permeable sheet cover member comprises a water absorbent fabric.

14. A breathable article according to claim 12, wherein the air-permeable sheet cover member comprises a waterproof but vapour-permeable membrane.

15. A breathable article according to any preceding claim, wherein the sheet further includes a hollow depression or chamber provided in the first major face of the sheet in the region of each perforation.

16. A breathable article according to claim 15, wherein the depression or chamber is so configured and arranged as to permit air passing from the first to the second side of the article to accumulate in the depression or chamber under increased vapour pressure prior to passing out to the second side of the article.

17. A breathable article according to claim 15 or 16, wherein at least one of the depressions or chambers is associated with more than one perforation.

18. A breathable article according to any one of claims 15 to 17, wherein the second major face of the sheet is provided with a dome projection in the region of each perforation, each dome projection corresponding with a hollow depression or chamber of the first major face of the sheet.

19. A breathable article according to any one of the preceding claims, when permanently or releasable affixed to the surface.

20. A breathable article according to any one of the preceding claims, being a cushioning or lining article for locating between a person or animal and a surface selected from the surfaces of apparel and clothing and portions thereof, seats and portions thereof, wheelchairs and portions thereof,

headwear, footwear, body protectors, body armour, sports shields, bedding, upholstery coverings, orthopaedic casts, orthopaedic supports, orthopaedic hard braces, and other articles against which the body of the person or animal, or a portion thereof, can be compressed in use.

21. A breathable article according to any one of claims 1 to 19, being a medical or veterinary dressing.

22. A breathable fabric comprising a sheet having first and second major faces and formed of a substantially impermeable material having perforations provided therethrough, characterised in that there is further provided a plurality of spacer members which project from at least one of the major faces of the sheet between perforations of the sheet for spacing the sheet in use from a part of a person or animal, from a surface, or from both of these on opposite major faces of the sheet.

23. A breathable fabric according to claim 22, wherein the spacer members project from at least the second major face of the sheet for spacing the sheet from the said surface.

24. A breathable fabric according to claim 23, wherein the spacer members project from only the second major face of the sheet.

25. A breathable fabric according to claim 22, wherein the spacer members project from at least the first major face of the sheet for spacing the sheet from the person or animal.

26. A breathable fabric according to claim 25, wherein the spacer members project from only the first major face of the sheet.

27. A breathable fabric according to any one of claims 22 to 26, wherein the spacer members project by a distance which is substantially the same across the relevant major face of the sheet.

28. A breathable fabric according to any one of claims 22 to 27, wherein the spacer members are discontinuous.

29. A breathable fabric according to any one of claims 22 to 27, wherein the spacer members are continuous.

30. A breathable fabric according to claim 29, wherein the continuous spacer members extend across substantially all of at least one side of the sheet.

31. A breathable fabric according to claim 29 or 30, wherein the spacer members comprise a network of ribs on the respective side or sides of the sheet.

32. A breathable fabric according to claim 31, wherein an air-permeable sheet cover member extends between adjacent ribs and is secured thereto to enclose an air space between the ribs.

33. A breathable fabric according to claim 32, wherein the air-permeable sheet cover member comprises a water-absorbent fabric.

34. A breathable fabric according to claim 32, wherein the air-permeable sheet cover member comprises a waterproof but vapour-permeable membrane.

35. A breathable fabric according to any one of claims 22 to 34, wherein the sheet further includes a hollow depression or chamber provided in the first major face of the sheet in the region of each perforation.

36. A breathable fabric according to claim 35, wherein the depression or chamber is so configured and arranged as to permit air passing from the first to the second side of the fabric to accumulate in the depression or chamber under increased vapour pressure prior to passing out to the second side of the fabric.

37. A breathable fabric according to claim 35 or 36, wherein at least one of the depressions or chambers is associated with more than one perforation.

38. A breathable fabric according to any one of claims 35 to 37, wherein the second major face of the sheet is provided with a dome projection in the region of each perforation, each dome projection corresponding with a hollow depression or chamber of the first major face of the sheet.

ABSTRACT

A breathable article, such as for example a medical dressing or a cushioning or lining article for locating between a person and a surface of (i) apparel or clothing, (ii) a chair, (iii) a wheelchair, (iv) headwear, (v) footwear, (vi) body protectors, armour and shields, (vii) bedding, (viii) upholstery coverings, or (ix) orthopaedic articles, is formed from an elastomeric (e.g. foamed neoprene) sheet 1. The sheet has first 2 and second major faces and small pin-prick sized perforations 6 provided therethrough in the centres of surface depressions or chambers 7 of the first major face 2 and corresponding dome projections 8 of the second major face.

Between the perforations 6 is provided a plurality of spacer members in the form of a network of continuous ribs 9 which project from the second major face and serve in use to space the sheet 1 from the surface to maintain breathability via the venting of air through the depressions/chambers 7 and the perforations 6.

The ribs 9 can have an air-permeable sheet cover member (not shown) secured thereto extending between adjacent ribs to enclose an air space between the ribs.

The invention also provides the corresponding breathable fabric from which the above breathable article can be produced.

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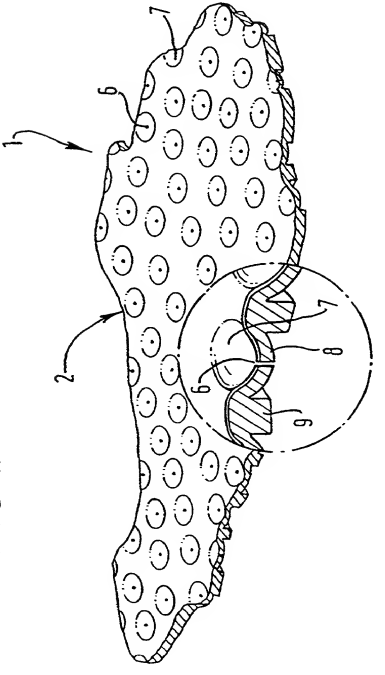

FIG. 1.

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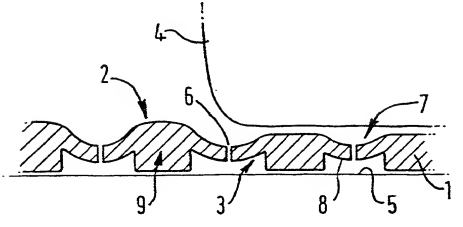

FIG. 2.

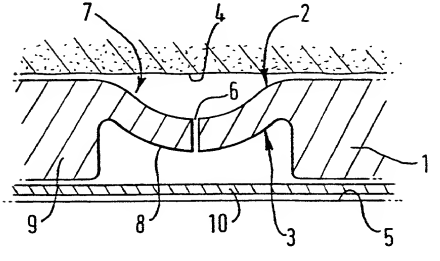

FIG. 3.

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare:

That my residence, post office address and citizenship are as stated below next to my name.

That I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: Breathable Articles and Fabrics the specification of which (check one)

☐ is attached hereto.

☒ was filed on 7 June 2001 as Application, Serial No. 09/857596 and was amended on _____ (if applicable).

That I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

That I acknowledge the duty to disclose information known to be material to patentability of this application in accordance with Title 37, Code of Federal Regulations §1.56(a).

That I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
9827412.9	GB	11/12/98	☒ Yes ☐ No
(Number)	(Country)	(Day/Month/Year Filed)	
			☐ Yes ☐ No
(Number)	(Country)	(Day/Month/Year Filed)	

That I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

United States Application(s)

(Application Serial No.)	(Filing Date)	(Status)-(Patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status)-(Patented, pending, abandoned)

That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

I hereby appoint the following attorneys, with full power of substitution and revocation, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith and request that all correspondence and telephone calls in respect to this application be directed to:

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Chicago, Illinois 60606-6402
USA

I hereby authorize the U.S. attorney or agent named herein to accept and follow instructions from David Leslie Brown, European Patent Attorney as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorney or agent and the undersigned. In the event of a change in the persons from whom instructions may be taken, I will so notify the U.S. attorney or agent named herein.

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Full name of additional joint inventor, if any: _____

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